Portal Filter Particle Collection Efficiency Using Monodispersed Aerosol

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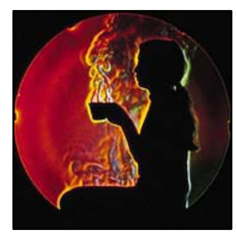
NIST has established the capability to evaluate the performance of air filtration systems. Although general filter specifications are usually available from manufacturers, many filter manufacturers know less about the performance of their filters for an aerosol of a particular size and composition. In a time of strong National Defense against terrorist attacks, an existing technology has emerged as one of the most effective means of detecting high-energy explosives and identifying potential perpetrators. Trace explosives detection systems are almost entirely based on ion mobility spectrometry (IMS) that relies on efficient microscopic-size particle sampling to concentrate trace explosives for subsequent desorption (heating) of these compounds into the IMS for detection.

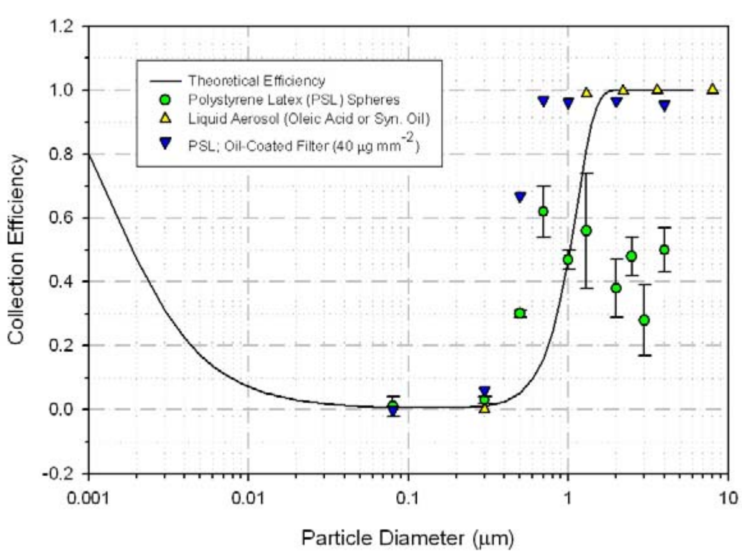
A CSTL research team along with the Transportation Security Administration and the Department of Homeland Security, have characterized the collection efficiency of the metal-fiber filter material used by the manufacturers of portal systems.

To meet the immediate need to screen people's clothing for trace explosives in a noninvasive way at airports and government facilities, two emerging portal technologies were designed to utilize air jetting and convective airflow to dislodge and transport microscopic particles from clothing to filters for desorption into an IMS system. However, prior to this work no data existed on just how efficient these filters were at collecting particles of known size and composition.

Commercial portal systems are based on airjet or convection airflow technologies



Filters were evaluated using airborne particles ranging in diameter from 0.08 µm to 8 µm at operational airflow velocities (10 m s^{-1}). The filter collection efficiency was measured by generating aerosol of known size using two standard methods, either a Collison Nebulizer for aerosolizing polystyrene latex (PSL) spheres or a vibrating orifice aerosol generator (VOAG) to produce sticky liquid oleic acid aerosol of known size. The dried and neutralized aerosol flows through a filter holder, with and without the filter in place, and into an optical particle analyzer to determine the particle concentration.



The filter efficiency is calculated from the concentration measured with and without the filter present. These results will likely lead to a better understanding of what size of explosive particles are collected, and consequently possible ways of improving the sampling and collection efficiencies.

The figure shows the filter collection efficiency plotted vs. particle size for different type aerosols. PSL variability is due to particle bounce. Collection efficiency is greater when filter fibers are coated with oil or for sticky particles, *e.g.,* oleic acid.

Future experiments will include the use of the VOAG to generate an aerosol of a high explosive and of a plastic binder, similar to a composite explosive (for example, C4) for evaluating filter efficiency and for developing a standard test surface for IMS. NIST capability of generating and counting monodispersed aerosol can be applied to virtually any filtration system.